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THINK ON THESE THINGS IN 1925

BENJAMIN FRANKLIN IN THE EIGHTEENTH CENTURY SAID

The Taxes are indeed very heavy, and if those laid on by the Government were the only Ones we had to pay, we might more easily discharge them; but we have many others, and much more grievous to some of us. We are taxed twice as much by our *Idleness*, three times as much by our *Pride*, and four times as much by our *Folly*; and from these Taxes the Commissioners cannot ease or deliver us by allowing an Abatement. However let us hearken to good Advice, and something may be done for us; *God helps them that help themselves*, as *Poor Richard* says, in his Almanack of 1733.

It would be thought a hard Government that should tax its People one-tenth Part of their *Time*, to be employed in its Service. But *Idleness* taxes many of us much more, if we reckon all that is spent in absolute *Sloth*, or doing of nothing, with that which is spent in idle Employments or Amusements, that amount to nothing. *Sloth*, by bringing on Diseases, absolutely shortens Life. *Sloth*, like rust, consumes faster than Labour wears; while the used Key is always bright, as *Poor Richard* says. But dost thou love Life, then do not squander Time, for that's the stuff Life is made of, as *Poor Richard* says. How much more than is necessary do we spend in sleep, forgetting that *The sleeping Fox catches no Poultry*, and that *There will be sleeping enough in the Grave*, as *Poor Richard* says.

If Time be of all Things the most precious, wasting Time must be, as *Poor Richard* says, the greatest *Prodigality*; since, as he elsewhere tells us, *Lost Time is never found again*; and what we call Time enough, always proves little enough: Let us then up and be doing, and doing to the Purpose; so by Diligence shall we do more with less Perplexity. *Sloth* makes all Things difficult, but *Industry* all easy, as *Poor Richard* says; and He that riseth late must trot all Day, and shall scarce overtake his Business at Night; while *Laziness* travels so slowly, that *Poverty* soon overtakes him, as we read in *Poor Richard*, who adds, *Drive thy Business*, let not that drive thee; and *Early to Bed and early to rise*; makes a Man healthy, wealthy and wise.

So what signifies *wishing* and *hoping* for better Times. We may make these times better, if we bestir ourselves. *Industry need not wish*, as *Poor Richard* says, and *he that lives upon Hope will die fasting*. *There are no Gains without Pains*; then *Help Hands*, for *I have no Lands*, or if I have, they are smartly taxed. If we are industrious, we shall never starve; for as *Poor Richard* says, *At the working Man's House Hunger looks in, but dares not enter*. Nor will the Bailiff or the Constable enter, for *Industry pays Debts*, while *Despair encreaseth them*, says *Poor Richard*. What though you have found no Treasure, nor has any rich Relation left you a *Legacy*, *Diligence is the Mother of Good-luck* as *Poor Richard* says, and *God gives all Things to Industry*. Then *plough deep*, while *Sluggards sleep*, and *you shall have Corn to sell and to keep*, says *Poor Dick*. Work while it is called To-day, for you know not how much you may be hindered Tomorrow, which makes *Poor Richard* say, *One To-day is worth two To-morrows*, and farther, *Have you somewhat to do To-morrow, do it To-day*. If you were a Servant, would you not be ashamed that a good Master should catch you idle? Are you then your own Master, be ashamed to catch yourself idle, as *Poor Dick* says.

THEODORE ROOSEVELT IN THE TWENTIETH CENTURY SAID

I extend pity to no man because he has to work. If he is worth his salt, he will work. I envy the man who has a work worth doing and does it well. There never has been devised, and there never will be devised, any law which will enable a man to succeed save by the exercise of those qualities which have always been the prerequisites of success, the qualities of hard work, of keen intelligence, of unflinching will.

A GUIDE FOR BEGINNERS IN CHICKEN RAISING¹

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WITH ONE PLATE AND SIX FIGURES

The raising of chickens, if properly developed, could be a prominent branch of Philippine agriculture, and the products derived from the industry an appreciable factor in the commerce of the Islands. The local environmental conditions,—uniform climate, loose fertile soil, rich water supply, plenty of naturally occurring feeds all the year round,—are favorable to profitable chicken raising in this country. The ease with which chickens adapt themselves to new conditions makes it possible to grow them as a side issue with almost any vocation. Also chicken raising is an industry in which all the members of the family can take an active part; the chickens being small animals and harmless, even children can help take care of them. The demand for chicken products, eggs and poultry, is ever increasing. With all of these advantages, to say nothing of the pleasure and satisfaction derived from the keeping of chickens, there would seem to be no reason why most Philippine families should not keep enough chickens to amply supply their needs, at least.

The importance of chicken raising is gradually being recognized in the Philippines as the increasing number of inquiries that come to this department show. This guide was written to meet the many demands for information on chicken raising; if the principles and advice here set forth are of use to beginners, whether on a large or a small scale, the object of the department in publishing it will have been attained.

In this circular, the writer does not aim to give a set of directions that will meet all troubles of beginners in chicken raising, as this is impossible. Probably in most cases the common sense of the chicken raiser will play the most important rôle. The poultry raiser should have good judgment, which can be formed only by actual experience in caring for chickens and by carefully studying their habits and their manifold requirements. Knowledge gained from study and reading of published material on the subject of chickens will help to form good judgment and be a guide in special cases. It is hoped that the information given in these pages may be of help to the chicken raiser while he is getting his experience.

CLASSES OF CHICKEN RAISING

BACK YARD CHICKEN RAISING

The keeping of chickens in the small lots back of city and town residences is called back yard, or suburban chicken raising. There is no reason whatever why many residents of a city or of a town cannot supply a part of the family's table needs from a well cared for, well fed, and well managed flock of chickens. Kitchen and table scraps, which if thrown into the garbage can are wasted, can be converted into eggs and meat if fed to chickens before the scraps have started to decay. Men and women who work indoors all day will find rest and recreation

¹ Experiment Station contribution No. 261; Circular No. 5.

working outdoors taking care of chickens in their hours at home. Children can be taught to find interesting occupation in raising chickens. They will not only add to the family's support by so doing but will develop habits of industry and love for poultry.

FARM FLOCK RAISING

The keeping of chickens by residents of barrios and villages as a side line of general farming is known as farm flock raising. A farmer's home is hardly a real home without chickens; no farmer should be without them. Raising chickens on a small scale is so easy that if the farmer himself cannot take care of them, other members of his family can. In this country, in this kind of poultry raising the fowls find their own feed; the hens steal their nests, are exposed to unfavorable environment, and consequently lay but few eggs and raise only a few chickens. If, instead of such practices, the chickens were properly housed, given some additional feeds so that they would not have to spend most of their energy hunting for their subsistence, the eggs and meat would be more than double the present production.

CHICKEN FARMING

The raising of chickens on a farm devoted exclusively to the industry, where it is the principal source of the farm income is chicken farming. When carried on as a business, chicken farming is not a simple easy occupation. Many people think that for this business neither special fitness nor special training are required and that it can be gone into without preliminary preparation. They do not realize that chicken farming requires brains, ability, experience, and the exercise of care and judgment in all the operations on the farm. The beginner in chicken farming will find that it will be to his distinct advantage to start on a very moderate scale and get experience in all of the phases of the business before he makes large investments in it. He can enlarge his capacity gradually as he feels himself growing in competency. A right beginning is always a prerequisite of a successful ending, and the beginner in chicken farming will be the gainer if he learns the business little by little.

BREEDS TO USE

ORIGIN OF THE NATIVE FOWL

The domesticated Native fowl in this country is only a few steps removed from his ancestor, the wild fowl (*Gallus bankiva*). In places near forests, these wild fowls are often seen mingling with the Native chickens and if left undisturbed, they remain and reproduce under these conditions, and in time become domesticated. The more improved standard breeds of fowls in this country represent some centuries of domestication.

CLASSIFICATION OF BREEDS OF FOWLS

The different breeds of chickens may be arbitrarily classified into groups, according to the purpose for which their type appears most efficient and for which they are supposedly bred. These breed groups are: (a) Egg Breeds; (b) Meat Breeds; (c) General Purpose Breeds; and (d) Fancy Breeds.

Egg Breeds.—These breeds are characterized by their rather small size. They are layers of large white eggs; are active and nervous in temperament, early maturing, non-sitters, and because of their activity, are good foragers.

These breeds are clean-legged, that is, they have no feathers on the shanks; they have white or creamy white earlobes. Leghorns, Minorcas, and Anconas belong to this group.

Meat Breeds.—These breeds are large, phlegmatic, slow in movement, and quiet and gentle in disposition. They are poor foragers, and, as a rule, are poor layers. Most of the meat breeds lay brown-shelled eggs, and in general are sitters and make good mothers. Some of the ones with feathered shanks, however, are inclined to be clumsy and are apt to step on the chicks. The birds of this group are late maturing. Brahmas, Cochins, and Langshans are the principal breeds of this group.

General Purpose Breeds.—These are medium-sized fowls, good layers, and their carcasses are well suited for the table. They are less active than the egg breeds, but more so than the meat breeds. They are layers of brown-shelled eggs. The general purpose hens are good sitters and make fine mothers. Where they are kept, natural methods of incubation and brooding can be used. They are fairly good foragers. Plymouth Rocks, Rhode Island Reds, and Wyandottes belong to this group. The Cantonese is also a general purpose fowl.

Fancy Breeds.—The birds of this group may be characterized by the decided beauty of plumage or form or because of their rare or unusual appearance. They often possess considerable economic value, but most of them are raised chiefly as ornamental fowls without regard to their useful qualities. Frizzles (*baligtad*, Tag.), Silkies, and Bantams belong to this group.



Fig. 1.—A flock of Cantonese pullets. These birds are similar in general make-up, but different in temperament. The ones near the edge are shy; they are the poor producers.

WHAT BREED TO USE

There are a number of factors that will aid in choosing the kind of fowls to keep. In the first place, the breed desired should be available and fairly cheap. Standard bred fowls are very rare in the Philippines, and, for this reason, are

expensive. Besides, they do not thrive very well in this country. The Cantonese for the general farm is a fairly good general purpose chicken and is very hardy. It thrives well in practically any kind of environment and is easily obtained and cheap. Beginners who cannot afford to buy both Cantonese hens and roosters, should, at least, use a Cantonese rooster to mate with their Native hens.

If it is desired to raise standard bred fowls, a general purpose breed should be given preference, as there is as much demand for eggs as for poultry. Of the several imported general purpose breeds, the one that has been found best adapted to the local environment should be selected. In this College, the Rhode Island Red and the Barred Plymouth Rock have proven to be better than other breeds in this respect. Experience in various other places seem to point to the same conclusion. Mono-purpose breeds, as Leghorns for instance, find their most appropriate places only on rather highly specialized poultry farms.

SELECTING THE LAYING STOCK²

VIGOR

A sound body is a requisite of a good laying hen; she should be vigorous and healthy. Vigor and health are shown by a bright, clear eye, a well set body, active disposition and a good circulation. The hen must be free from physical defects, such as crooked beak, excessively long toe nails, eyelids that overhang so that she cannot see well, scaly leg or any defect that would keep her from getting an abundance of food.

TYPE

The general make-up of a hen indicates the rate of her egg production. To make a record, a hen must not only lay for a long time but also heavily. To do this, she must have sufficient body capacity to digest large amounts of food rapidly. This capacity in a laying hen is shown by a body that is deep, a fairly straight under line and a fairly horizontal back. The back should also be flat and wide with the width carried well back to the tail. The back that tapers decidedly or slopes down indicates poor capacity for digestion. The breast should be full, deep, and prominent. The neck should be fairly short and well set. The legs should be of moderate length. The long-legged round-shanked hen is not a good layer. The keel bone should be long and generally curved.

The head should be moderately fine with large bold eyes set well out on the side of the head in an oval eye socket. The head should be wide and flat at the top, and wider on top than below the jaws. A flat-headed, bony or crow-headed, small round-eyed, or cross-eyed bird or one with overhanging eyebrows, or having a comb with extremely narrow serrations is not likely to be a good egg layer.

SIGNS OF LAYING

A laying hen has a large, moist vent, showing a wide, dilated condition and looseness, while a hen that is not laying has a hard, round, dry, puckered vent. The whole abdomen, as well as the vent, is dilated so that the pelvic arch is wide-spread and the keel forced down away from it. The greater the number of eggs

² The discussion on this topic was taken largely from the report adopted by The American Association of Instructors and Investigators in Poultry Husbandry. (1)

a bird is going to lay in succeeding days, the greater will be the size of the abdomen. Its actual size is influenced by the length of the keel, the size of the eggs laid, and by the size of the bird. A sagging abdomen is undesirable.

The quality of the skin and the thickness and stiffness of the pelvic bones indicate heavy production. With egg-laying, fat disappears from the skin and body so the good producers have a soft velvety skin that is not underlaid with layers of hard fat. The abdomen in particular is soft and pliable. The sternal processes are very prominent and are generally bent outward. The thicker and the blunter the pelvic bones and the greater the amount of hard fat in the abdomen, the less the production. This condition indicates also the time since production stopped.

If the comb, wattles, and ear-lobes are large, full, plump, and smooth, or hard and waxy, the bird is laying heavily. If the comb is limp, the egg production is only light. When the comb is dried down, especially at the time when the hen is shedding her feathers she is not laying at all. If the comb is warm, it is an indication that the bird is coming into production.

TEMPERAMENT AND ACTIVITY

A good layer is active, intelligent, friendly, and more easily handled than a poor layer. She is almost always the first one to leave the roost in the morning. A low producer is shy and flighty and stays near the edge of the flock most of the time. A poor layer will always squawk when handled.

HOUSING

Chicken houses should be made to imitate the birds' natural habitat. They should be dry, roomy, airy but not drafty, and should afford protection against wild animals. Such a house can be built in the Philippines at little cost and not much labor. The common practice of housing under dwelling houses cannot be too emphatically condemned. Besides being unsightly, it is insanitary for the family and not good for the chickens. If the chickens are housed in a separate shed very close to the residence, the protection from night marauders, both human and animal, will be secured.

LOCATION

Care should be taken to select a high and dry place for a poultry house. There should not be any place near where water can collect and become stagnant during the rainy season. Dust in the dry season can be prevented by growing a permanent sod around the house. The ground surrounding the house should be tilled at least once a year to prevent its becoming sour. There should be enough space near the house to grow crops for the chickens. Finally, the site should be laid out so as to provide for future expansion.

There should not be any thick growths near the chicken house as these serve as hiding places for *bayawak*, *alimos*, *musang*, and other wild animals. There should, however, be plenty of natural shade and green grass near by, for these are good breeding places for insects, worms, and bugs, besides providing seeds of weeds which may be relished by the chickens. A very large run will also minimize the annoyance caused by the chickens going in the owner's house. Plenty of feed and a good grassy run will help break this bad habit.

THE POULTRY HOUSE

A good chicken house can be made out of bamboo with either nipa or cogon for roofing, and for those living in cities or towns cheap packing boxes and petroleum cans can be utilized. Nests can be made out of woven bamboo strips or out of kerosene packing boxes. Drinking troughs can be made of bamboo joints or an open vessel, either earthen or metal, will answer.

Poultry feeds can be stored in petroleum cans, which are cheap and rat proof and if painted will last a long time. Such rat proof containers, properly covered, will soon pay for themselves in the feed saved from being wasted or eaten by rats.



Fig. 2.—A cheap chicken house, completely equipped.

FENCING

On the farm, the chickens should be allowed the run of the fields but vegetable and flower gardens should be fenced and protected from them. Being allowed to run in the fields chickens can forage for themselves and pick up bugs, insects, worms, and stray grains. By consuming bugs and insects, which make excellent animal food for the chickens, they help protect the crops against these pests. Also in running over the farm they deposit droppings which aid in fertilizing the soil.

In cities and in towns the chicken lot should be fenced. The chickens, however, should not be confined too closely, as this will help increase danger from disease. If the lot is large enough, it should be divided into two parts and each lot cropped to corn alternately. When thus fenced in, the chickens should be given more care and better feeding than when they are allowed to run at large.

FEEDING

ESSENTIALS OF POULTRY FEEDING

Chickens should be given feeds that are nutritious and palatable; they should be neither too bulky nor too concentrated. They should not have any bad effect upon the system of the bird, nor should they impart any undesirable flavor to the eggs. Above all, the feeds should be easily secured and cheap and, if possible, they should be only products and by-products that would otherwise go to waste on the farm. These feeds should be given in the form of grain, either whole or cracked, and mash consisting of finely ground products, fed either dry or wet. The grain feeds furnish the greater part of the carbohydrates and the mash supplies most of the proteins.

WHAT TO FEED

Table I gives a list of feeds available for poultry feeding in the Philippines. This table was derived from Appendix Tables I, II, and III in Henry and Morrison's "Feeds and Feeding" (2), and from various other sources. Whenever possible, the digestible coefficients for poultry were used, otherwise, the digestible coefficients for ruminants were employed with the fiber free, inasmuch as poultry cannot digest fiber (3). The amount and cost of these feeds vary according to the time of the year and the locality. A judicious selection and a careful combination of such feeds as are available is necessary to feed a flock with profit, as no single feed contains all of the necessary nutrients and accessories in the proportion that is needed by fowls.

TABLE I.—Showing the average analysis and digestible nutrients in 100 kilograms of feeds that may be available for poultry.^a

Feeding stuff.	Total ash.	Total crude fiber.	Digestible nutrients.		
			Crude protein.	N-Free extract.	Fat.
Corn, cracked.....	1.5	1.5	8.9	63.2	4.3
Corn meal.....	1.3	2.3	7.0	64.1	3.4
Corn bran.....	2.4	9.8	5.8	49.9	4.6
Rice, rough.....	4.9	9.3	4.7	61.4	1.7
Rice polish.....	4.8	1.9	8.0	56.7	7.5
Rice shorts (<i>binlid</i>).....	2.2	0.8	9.2	71.7	2.0 ^b
Rice bran.....	13.2	13.6	6.9	34.1	6.3
Rice meal.....	9.1	9.3	7.3	44.8	10.6
Sorghum.....	1.9	2.0	7.5	59.5	2.6
Copra meal.....	7.3	15.7	15.8	35.6	5.8 ^b
Cowpea.....	3.4	4.1	19.4	51.9	1.1
Soy bean.....	5.3	4.3	30.7	19.3	14.4
Soy bean, fat extracted..	5.4	5.3	38.1	28.7	5.0
Mungo.....	3.0	4.4	20.4	56.6	0.9 ^c
Sunflower seed.....	3.1	27.9	13.5	15.1	20.3
Peanut without hull....	2.2	2.6	24.1	14.7	40.4
Peanut, waste.....	5.4	6.2	22.0	13.0	30.1
Cow's milk.....	0.7	—	3.3	4.9	4.3
Whey.....	0.7	—	0.8	4.7	0.3
Fish meal.....	32.0	—	40.9	—	2.2
Dried shrimps.....	19.7	4.2	55.6	3.3	2.6 ^b
Snails, fresh.....	6.1	—	7.6	7.3	0.8 ^b
Fresh bone, ground....	21.1	—	18.3	—	24.5
Bread.....	1.5	0.7	5.8	51.5	0.5
Bakery refuse.....	5.2	0.5	8.3	60.5	7.0
Cabbage, outer leaves...	3.1	2.8	1.7	4.3	—
Mixed grasses.....	1.8	10.6	1.7	8.6	0.6
Potato.....	1.1	0.4	1.1	15.7	—

^a Derived from Appendix Tables I, II, and III in Henry and Morrison's "Feeds and Feeding," 1917, and from other sources.

^b From analysis reported by the Department of Chemistry, College of Agriculture, University of the Philippines.

^c From analysis reported by the Bureau of Science, Manila.

COMPOUNDING OF POULTRY RATIONS³

As a general rule, poultry feeding is carried on with one of four productive purposes in view: (1) laying, (2) growing, (3) fattening, or (4) breeding. The ration should be adapted to the purpose, otherwise there will be an unnecessary waste of nutrients. Laying rations should contain more protein than carbohydrate and should be given in form of grain, whole or cracked, and mash mixtures. The growing ration for young chicks is similar to this except that the ingredients are less in quantity and the proportion of both ash and protein is greater. The fattening ration should be in such form, condition, consistency, and palatability as will facilitate consumption of large amounts, and insure rapid digestion and assimilation. This is made up entirely of grain, either whole or ground. The breeding ration, in general, is frequently the same as the laying ration.

HOW TO FEED POULTRY FOR PROFIT

There is no hard and fast rule as to the particular poultry ration to use. A certain ration found profitable under one set of conditions may be a failure under another, and feeds available and cheap in one region may not be in another. The safest guide is to use whatever feeds are available, the proportion of the different ingredients to be governed according to the object in view.

Feeding the young newly-hatched chicks.—Hard boiled infertile eggs, chopped very fine, shell and all, and mixed with four to five times its bulk, either of bread crumbs, boiled rice, or rice bran may be given to newly-hatched chicks. This mixture should be given at regular intervals, four to five times during the day, giving only a little at a time. Fine grit, plenty of green feed, and clean cool water should be available to the chicks at all times. This mixture can be fed to them during the first week of their lives, about one egg to every thirty chicks a day.

Feeding the older chicks.—A mash mixture composed of two parts by weight of rice bran, one part of rice shorts (*binlid*), one part of copra meal, and one part of dried shrimps may be given four times a day. If dried shrimps are not available, either ground snails or *anay* may be fed at noon, giving enough to keep the chicks busy for about twenty minutes. Fresh clean table scraps may be used to great advantage. The chicks, in addition to this, should be given a chance to run out in the yard as much as possible, and receive plenty of sunlight which is essential for their normal growth.

Feeding the growing stock on a wide run.—Young chickens kept on a wide run may be fed either cracked corn or palay or both, and a mash mixture composed of one part each by weight of rice bran, of rice shorts (*binlid*), of corn meal, of copra meal, and of dried shrimps. This mash mixture should be available to the birds all day. If shrimps cannot be secured, some form of meat food as ground snails or *anay* should be given instead. Fresh table scraps may also be given. If the runs have a good vegetation, the chickens may get enough insects, bugs, and worms to supplement the feeds given them.

Feeding the laying hens.—A very simple, fairly cheap laying ration, and one which may be easily secured is:

- Grain: Cracked corn or an equal mixture of corn and palay.
- Mash: 2 parts rice bran
 - 1 part rice shorts (*binlid*)
 - 1.5 parts of copra meal
 - 0.5 part dried shrimps.

³ In poultry husbandry, the term *ration* usually refers to the composition of the daily diet of fowls.

Where a corn grinder is available, one part corn meal may replace one of the two parts of rice bran. The meat food may be omitted from the mash if it cannot be obtained at a reasonable price and table and kitchen scraps given instead, and enough ground snails to keep the chickens busy for about twenty minutes at noon.

Feed the hens only enough grain to partly fill their crops in the morning so that they will hunt for more out in the run and thus get exercise. Feed the mash in troughs left open all day; if wet mash is given, feed only enough to keep the chickens busy for about ten minutes at noon. Before the birds go to roost at night, give them all the grain they can consume so that they go to rest with their crops full.

It should not be forgotten that laying hens need plenty of clean cool water. The drinking troughs should be cleaned and refilled at the time the hens are given their morning grain. Green feeds stimulate the production of eggs, and for this reason a good sod around the poultry house is a necessity. A wide grassy run is also necessary, for too close confinement in a barren yard favors a quick souring of the soil and the multiplication and spread of disease germs and parasites.

Feeding for fattening.—Corn is one of the best grains for fattening chickens. Confine the birds to be fattened in a small pen and give them all the corn grain that they will consume readily. Do not give too much at a time or they will tire of it. Continue feeding them this way until the birds are fat enough to satisfy the feeder.

A mash of equal parts of corn meal and rice bran, moistened to a sloppy condition, is a good fattening feed. Confine the birds in a small cage and fast them for about twenty-four hours before giving them the mash. Soft boiled rice may be added with advantage to this mixture. Chickens may be fattened on boiled rice alone. The birds that are being fattened should not be disturbed, and, if possible, the fattening cages should be placed in semi-dark corners. The birds may become fat in a week, but this depends of course upon the degree of fatness desired. In any case, the fattening process should not last more than two weeks as the birds begin to lose weight after about that length of time.

INCUBATION

Only eggs from vigorous and healthy birds should be used for hatching purposes. These eggs should be uniform in size, shape, and color, and the shells should be sound in texture and free from ridges and excrescences. The belief that the long, narrow eggs hatch only male chicks and the short, round ones only female individuals is unfounded. Either kind will in the long run produce females and males, about fifty-fifty. The eggs to be hatched should be as perfectly oval in shape as possible. The egg shell provides a perfect natural protection against disease germs, but when dirty eggs are washed the natural protective covering of the eggs is rubbed off. More vigorous chicks will be hatched

from unwashed than from the washed eggs, and for this reason, unless the eggs are extremely dirty, they should not be washed if they are to be used for hatching.

HOLDING HATCHING EGGS

When holding eggs for hatching, care should be taken that they are kept in a dry, airy, cool place. Hatching eggs should not be held too long; ten days is the longest even under the very best of conditions, and only in exceptional cases should eggs more than fifteen days old be incubated (4). A common practice all over the Philippines is to store the eggs in small receptacles containing *palay*, rice bran, or rice hulls. This certainly will help to minimize breakage during holding the eggs previous to hatching, but the bad result of the practice is that such containers are apt to be warm, thus favoring evaporation from the eggs and allowing the embryo chicks inside the eggs to develop. This method of holding, however, is much better than letting the eggs stay in the nest uncollected from the time the first egg is laid until the last chick has hatched. This is a wasteful practice, as the number of rotten eggs, especially during the dry season, is large. The eggs should be gathered every day, with probably one or two eggs left in the nest to serve as bait. A good way to store eggs is in a basket lined with stripped fresh banana leaves renewed from time to time, as such a holder is cool and well ventilated. Hatching eggs should not be kept near odorous substances as kerosene, gasoline, oil, onions, etc., as eggs absorb these odors readily and it spoils them.

ARTIFICIAL AND NATURAL INCUBATION

Whether incubation is artificial or natural, the principles involved are the same. The artificial incubator is an imitation of the natural process, but there are certain limitations which should govern its use. Although it has been found to be possible to carry on artificial incubation successfully without the use of an especially built cellar, (5) it is only advisable when poultry raising is done on a large scale. If it is desired to hatch eggs artificially, miniature-sized incubators, 70 to 85 egg capacity, will be found the most desirable for beginners.⁴ As a warning, however, the operator is cautioned to exercise special care in running an incubator as the danger from fire is very great.

Hatching with hens, even with as many as one hundred, is the most practical. Natural hatching is safer, more reliable, and more economical than artificial hatching. No previous experience is necessary. One of the drawbacks in the use of natural incubation is that it is difficult to raise chicks that are free from lice and mites.

The sitting hen.—Care should be exercised in selecting hens for hatching. Only the tame, vigorous, and healthy ones should be chosen. Above all, the

⁴ Detailed directions for operating an incubator are furnished by the manufacturer.

hens should be fairly large and broody. Hens that are badly infested with lice or with scaly legs should never be used for sitting.

The hatching nest.—The hatching nest should be roomy and placed where it is cool and well ventilated. It should not be placed so high that the hen will have to fly into it, nor so low that she will be annoyed by dogs and other animals. The nesting materials should be soft and pliable and arranged in the nest so as to form a hollow hemisphere which will prevent the eggs from breaking or rolling out from under the hen. If hatching is done during the warm months, a layer of moist earth may be placed in the bottom of the nest under the nesting material to help reduce the evaporation from the eggs and to slightly increase the percentage of hatch.

Management of the sitting hen.—The sitting hen should have at her disposal plenty of clean cool water and whole grain, either corn or rice. She should be provided with a place where she can dust herself freely. A very fine mixture of one part ordinary clean road dust, two parts of wood ashes, and one part of lime placed in an open box near the hatching nests will be satisfactory for this purpose. The nesting material should be burned after every hatch and the nest thoroughly cleaned. The droppings inside and around the nest, as well as eggs that may be accidentally broken, should be removed promptly and the dirty nesting materials should be replaced with clean. During the very warm months, mites multiply very rapidly and greatly annoy the sitting hens, reducing their vitality and sometimes causing their death. Only strict sanitary precautions will prevent these pests from troubling the sitting hens.

When to hatch.—It has been observed that better hatches may be obtained from eggs incubated during the cooler months, from October to February, than during any other month of the year (4) (5). Except during the latter part of this period, January and February, egg production is very low (6) (7) (8). The eggs produced during the months from October to December should be sold to take advantage of the high price owing to scarcity in the market. Hatching during the rainy and stormy months, from June to September, has a disadvantage in that it is very hard to raise young chicks when they are exposed to very uncertain weather conditions. It is unquestionably much better to hatch eggs during the dry season, January to May, the earlier in the season the better, for then the chicks can be easily raised. Another advantage is that there is usually not much work on the farm during these months, hence more time and attention can be paid to the care and management of the young chicks. Later in the dry season, when the weather is warmer, extra care in holding the eggs and in the preparation of the hatching nest must be exercised (3) (4).

Number of eggs to each hen.—A setting consists of fifteen eggs. This number may be varied according to the size of the hen to be used. During the warm months, seventeen or even eighteen eggs may be safely placed under one hen.

In exceptional cases as many as thirty eggs have been placed under a hen with satisfactory results. After the seventh day of incubation the eggs may be tested and the infertiles and those that have dead germs taken out. Three hens may be set at the same time, and after testing and culling out the infertiles and those having dead germs, the remaining eggs may be placed under two hens, and the third one given a fresh supply of eggs.

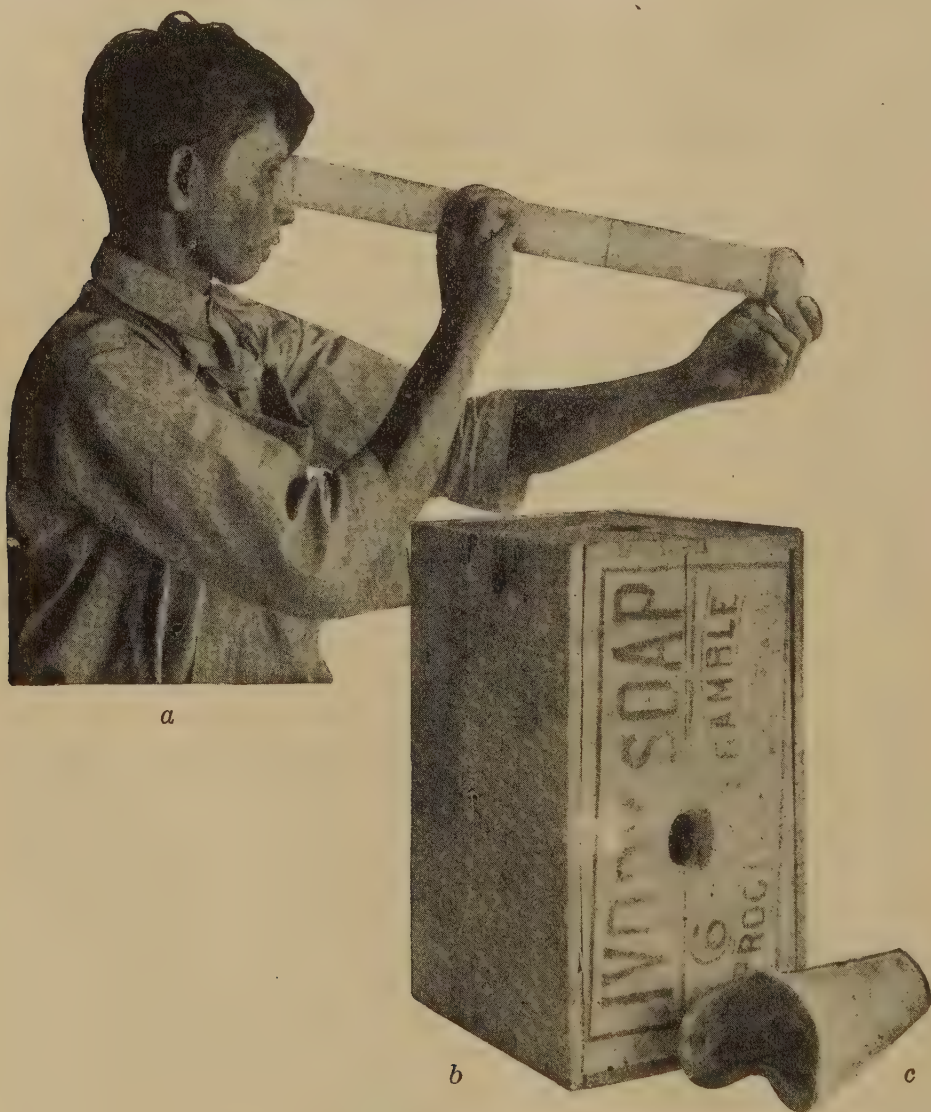


Fig. 3. Candling devices.—*b*. Lamp candler made from a box. The lamp is placed inside the box, and the egg to be candled is placed against the hole. *a* and *c*. Day-light candlers. The man is shown candling an egg with a tube of ordinary stiff paper.

Testing.—The eggs are generally tested two times, on the seventh and on the fourteenth days of incubation. In the first testing, eggs that appear clear except for a slight floating shadow due to yolk are referred to as “infertiles.” These may be eggs that have never been fertilized, or fertilized eggs in which the

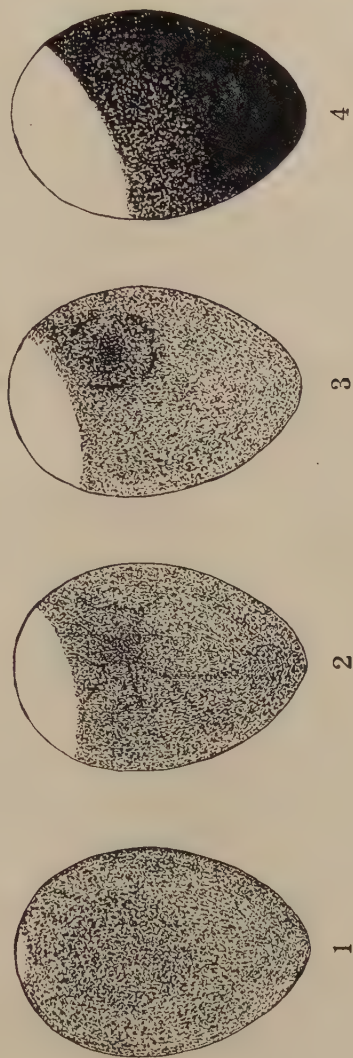


Fig. 1. Appearance of a fresh egg before a candle. Note small air cell at large end of egg. The dark body near the center is the yolk.
 Fig. 2. Appearance of a fertile egg on the seventh day of incubation. Living embryo is represented by spider-like structure near center of egg. The air cell has become much larger than that of a fresh egg as shown in Fig. 1.
 Fig. 3. Appearance of a fertile egg on seventh day of incubation, but with a dead germ. The dark ring is characteristic of almost all such eggs.
 Fig. 4. Appearance of a fertile egg with a living embryo on the fourteenth day of incubation. The air cell occupies almost one-third entire egg, and young chick occupies other two-thirds.

germ has died so early that it can not be distinguished in testing. The egg that has a spider-like structure inside has a living germ, the dark figure in the center being the body of the embryo chick and the radiating lines, the blood vessels. If the germ is dead, it may be recognized by the presence of a dark ring or by the absence of the blood vessels; in most cases the dead germ is stuck to the shell. Doubtful cases should not be removed. At the second testing on the fourteenth day of incubation, the living embryo will nearly fill the egg, while the egg with a dead embryo will appear fairly clear, depending upon the age of the germ when death took place. Hens' eggs will normally hatch 19 to 21 days after placing them under a hen. There may be a few eggs that will hatch a few days later, but these are considered abnormal hatches.

BROODING

NATURAL BROODING

The hen is the practical brooder, except where artificial incubators are used. A tame, quiet, motherly hen should be used. Young tame capons are frequently employed as brooders. Whether capons or hens are used, they and the young brood should be provided with a coop to protect them in bad weather and from animal enemies. A fair sized shady and grassy run for the young chicks is a necessity for successful brooding.

CARE AND FEEDING OF YOUNG CHICKS

The newly hatched chicks should be taken from the nest about twelve hours after the last chick has hatched out of the shell. The first feed should not be given until about two days later. This first feed should be soft and nourishing. The eggs that did not hatch may be boiled hard, chopped fine, and mixed with either rice bran, boiled rice, or bread crumbs. This feed may be given to the chicks at regular intervals during the first week and interchanged with harder though finely ground feeds until the chicks are large enough to pick up ground grain. Table scraps may be fed with great advantage, providing they are fresh and wholesome. Cleanliness, regularity of feeding, use of feeds rich in protein, as ground snails, *anay*, fish scraps, etc., a plentiful supply of clean, cool water, and a wide, grassy, and shady run are essential requirements in brooding chicks during the first weeks.

CAPONIZING⁵

The best time to caponize a cockerel is when the comb has become so red that he can be easily distinguished from a female. Under ordinary conditions, only one rooster to every ten to fifteen hens is necessary, and the surplus cockerels should be caponized so that they can be more profitably raised and marketed. A capon grows larger, yields tenderer and juicier meat than a rooster. Also a capon is much less troublesome and less restless than a rooster and does not annoy the pullets. Roosters are not only smaller than capons but produce dry, tough, and very fibrous flesh.

⁵ The process of removing the testes of male birds. A capon is an unsexed male bird.

Caponizing by the native method⁶ is slower and more dangerous than the more scientific process, and the percentage of mortality is considerably higher. The essential instruments used for the scientific operation are a knife, a pair of spreaders, a hook, a probe, and a spoon or a pair of forceps.⁷

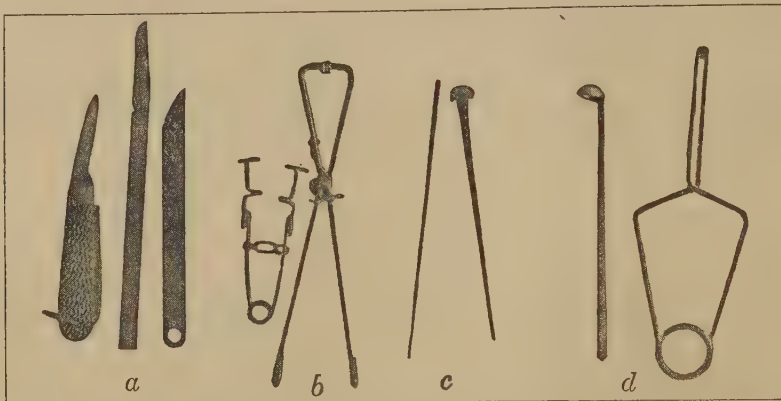


Fig. 4. Caponizing instruments.—*a*. Different kinds of knives for making the incision through the side of the cockerel. *b*. Spreaders, for opening the wound so as to facilitate removal of the testes. *c*. Hook for tearing the peritoneal membrane. The other end of the hook may be made rounded to serve as the probe for locating the testes. *d*. Spoon and a pair of forceps, either of which may be used for removing the testes. The hook and the spoon may be combined in the same instrument as shown in *c*.

The testes are removed through a slit made between the last two ribs of the bird, after the feathers in this region have been plucked off. When the slit is properly made no sewing is necessary as the skin of the fowl covers the hole made. It is always safer to remove the testes by making two slits, one on each side of the bird. It is advisable for a beginner to first operate upon a cockerel that has been killed for the purpose. Skill and knowledge thus obtained will lessen the number of deaths from the operation. Birds that die as a result of the caponizing operation soon after it is performed are still good for food.

If the bird has been properly prepared, that is, fasted for at least twelve hours, an experienced operator can caponize it in three to five minutes. Care should be taken to remove the testes entirely, otherwise, slips will be formed. Newly caponized birds should be given a little soft feed and water. If, a day or two after the operation, the skin of any of the birds is puffed, pricking the skin with a knife or a large needle to let the air out will relieve the trouble. Capons, if properly made, can be marketed with profit around eight months of age (9). The gains made after this are no longer economical.

⁶ The testes are removed by the operator's fingers from a hole made in the abdomen of the bird after which the hole is sewed up.

⁷ A good set of caponizing instruments can be bought from Botica Boie, Manila, for about ₱10.00. A set can be made by a silversmith for less than this amount.



Fig. 5.—Caponizing. An inverted barrel will serve for a caponizing table.

How to train a capon to take care of chicks.—If the capon is tame, no special training is necessary. The chicks may be placed under him at night, and the following morning he will take them around like a mother hen. However, it will usually be found necessary to give a capon special training before he can be trusted to look after a brood of chicks.

The first step in the training is to confine the capon in a box so narrow that he cannot turn around and so low that when it is covered with wire netting or slats made of bamboo or wood, he cannot stand, thus forcing him to remain in a sitting position. The capon is kept in this box all the time except when being fed and watered. After a day or two he will learn to sit down at regular intervals. The chicks may then be placed under him at night. Tame capons may be trusted to take care of young chicks after two or three days of training, but if the capon is semi-wild, a week or more may be necessary. It is advisable not to give a capon chicks that are less than one week old. When younger, the chicks are so small and weak that they are likely to be crushed under the capon's feet. (10)

MANAGEMENT OF THE LAYING STOCK

SIGNS OF MATURITY AMONG PULLETS

The most common signs of maturity in a pullet are enlargement and reddening of the comb and wattles, enlargement of the vent, greater activity and a

happier disposition as shown by her cackling a great deal. Small pieces of scab may be seen sloughing off the comb and wattles. These and the earlobes become warm to the touch. The abdomen of pullets coming to maturity expands as a result of the enlargement of the digestive and reproductive organs.

NUMBER OF HENS TO A ROOSTER

Contrary to the general belief, hens will lay without roosters among them. If the eggs are not intended for hatching, no male birds should be allowed to run with the hens, except when they run at large when a rooster is necessary to keep them together and from roaming from the owner's homestead. If fertile eggs are to be produced, there should be at least one rooster for every ten to fifteen hens. There should not be too many roosters in a flock or on a farm as roosters make trouble and even small disturbances in the flock annoy the ever-nervous young hens. Sometimes the presence of too many roosters on the premises cause the production of an unusually large percentage of infertile eggs.

CARE OF THE LAYERS

Laying hens should never be disturbed. There are no more excitable birds than a group of laying hens, and one disturbance in the flock may mean a number of eggs lost and even the death of a number of the hens from broken eggs in the oviduct. The poultry house and its immediate neighborhood should be kept clean and dry in order that clean eggs may be produced. The poultry house should be cleaned of poultry manure at least once a week. The manure is a good fertilizer and should not be wasted. Poultry raising is a clean occupation if the house and equipment are kept clean. The work often appears dirty and insanitary because the common rules of cleanliness are not observed.

BREAKING UP BROODINESS

As broodiness is a maternal instinct, the hens naturally desire to sit after laying a number of eggs—usually not more than a dozen. If it is not desired to hatch these eggs, the broodiness should be broken up so that the hen will not spend time idling. Various methods of breaking up broodiness, as starving the broody hen, dipping her in cool water, applying salt or ground pepper or both on the vent, and various other means have been recommended. These treatments, besides being inhumane, do not always work and the hens so treated do not generally lay again for some time.

When the hens are broody, their ovaries become inactive, and therefore the proper way to break their broodiness is to feed them very well so that they will soon lay eggs. One method, found satisfactory at the College, is to confine the broody hens in a roomy, well ventilated compartment provided with a hard floor made either of bamboo, wooden slats, concrete, or earth packed hard. While confined, the hens are given soft nourishing food, as wet mash. Hens so confined soon after they show broodiness will lose their desire to set after about four days, and will begin to lay again a few days after they are let loose or returned to the pens.

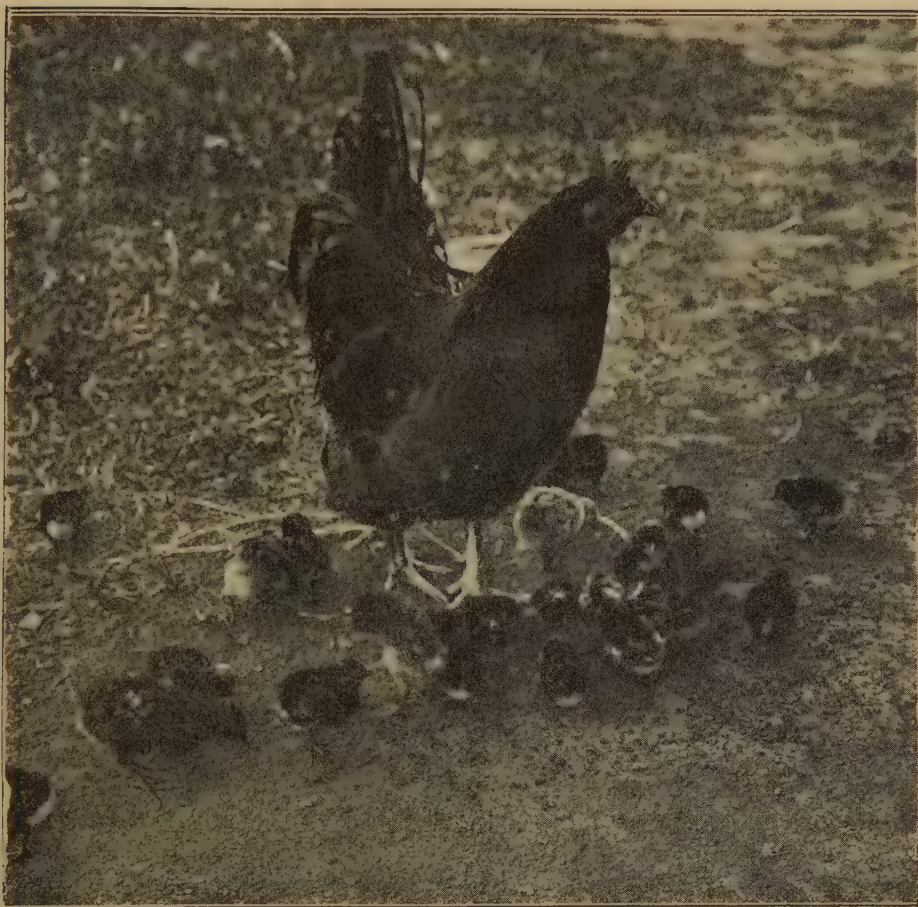


Fig. 6. A capon with young chicks.

NUMBER OF EGGS TO EXPECT

The records of the College flock for 1923-24 show that the number of eggs that may be expected from a flock of a certain number of hens varies according to the time of the year [see also (8)]. Based on experience in the College if the number of eggs a hen will lay in one year is expressed as 100 per cent, the number that may be expected each month may be given as follows:

Month.	Percentage of the total yearly production.	Month.	Percentage of the total yearly production.
January	8	July	10
February	12	August	7
March	15	September	6
April	13	October	4
May	10	November	3
June	10	December	2

When this egg production curve is assumed, it is taken for granted that the hens are not to be used to hatch their eggs and to take care of the chicks. If used for this purpose this distribution percentage will, of course, be modified accordingly.

DISEASES

The presence of a number of poultry diseases should not be considered as a deterrent in the raising of chickens in the Philippines, as the diseases can be largely controlled. If strict sanitation is observed danger from poultry diseases will be minimized. Cleanliness, regular supply of nutritious wholesome feeds, plenty of clean cool water, and good housing facilities including a large grassy and shady run will help to keep away poultry diseases. Only the most common poultry diseases are given in this paper. For a more complete discussion of poultry diseases found in the Philippines, the reader is referred to a previous publication on the subject (11).

ROUP

Roup (*sipon*, Tag.) is distinguished by a sticky discharge from the nostril, and in most cases, this discharge collects in the nostrils where it forms a cheesy mass causing a tumor-like swelling on the face beneath the eyes. During the early stages, the discharge is thin and watery, but becomes thick after a few days. The appetite decreases, the wings droop, and in general appearance, the bird shows signs of depression and illness. Young fowls are more susceptible to this disease than mature ones. Prevention is the best treatment. Only expensive birds need the individual treatment of cleaning the nostrils of the discharge and dipping the entire head for 20 to 30 seconds in a weak solution either of creoline or of potassium permanganate.

CHICKEN POX

Chicken pox (*bulutong*, Tag.) is distinguished by the wartlike knots found on the unfeathered portions of the head. Sometimes the whole head is inflamed, and the eyelids of the bird affected become swollen and stuck together. In the Philippines, it is mostly young birds that are affected, but in other countries, mature fowls generally contract the disease. Recovery without treatment may take place within two weeks, but this happens only with strong birds. The nodules may be burned with a red-hot wire, or painted with a strong solution of tincture of iodine after removing the crust. Isolate the affected birds from the healthy individuals to prevent the spread of the disease. Feed the chickens very well to keep them healthy and vigorous.

AVIAN DIPHTHERIA

Avian diphtheria (*sampaga*, Tag.) is distinguished by the presence of a membranous deposit on the mucous surface of the nostrils, eyes, mouth, throat, trachea, or bronchi. This deposit is at first thin and light in color, but becomes thicker and firmer later. It has the appearance of a flower, hence its local name *sampaga*. When it is removed, the surface beneath is seen to be inflamed, ulcerated, and bleeding. Local treatment of the diseased part is recommended. Remove the membranous deposit and paint the exposed tissue with either tincture of iodine, silver nitrate, or a strong solution of hydrochloric acid. Experienced keepers of game-cocks claim that they have had success by treating these raw tissues with the solution resulting from putting a copper coin in vinegar and allowing it to stand over night.

FOWL CHOLERA

The excrement of the birds affected with fowl cholera (*peste*, Spanish) is highly colored yellow and green, sometimes occurring together and sometimes separately. The sick bird isolates himself from the flock, the feathers are roughened, and the wings droop. Generally there is severe diarrhea. In some cases, the bird affected lives several days, but in acute cases, it dies within twelve hours after infection. Apparently healthy birds may go to roost in the evening and be found dead the following morning. Individual treatment is not advisable. Kill the sick birds immediately in order to prevent further trouble.

EXTERNAL PARASITES

Lice (*kuto*, Tag.) and mites (*hanip*, Tag.) do more harm to young birds than to the mature ones. These parasites so reduce the birds' vitality as to make them very susceptible to other troubles. Sitting hens are very much bothered by mites, and sometimes they leave the nests before the eggs are hatched. Cleanliness, dryness, good ventilation, and plenty of sunlight are very good preventives for the rapid increase of mites. A dust bath will help fowls very much in overcoming lice infestations. Sanitary surroundings and a wide dry range are the best preventives of external parasites. The presence of lice can easily be detected by looking for them either under the wings or around the vent.

SCALY LEGS

Scaly leg is a disease caused by mites burrowing under the scales of the legs and feet. The legs become very much enlarged and roughened, and in serious cases, the bird affected may become lame. The disease may be treated by brushing off the crusts after soaking the legs in warm soap suds and coating the cleaned portions with creolated vaseline. Dipping the legs in kerosene and coconut oil, mixed half and half, is another treatment that has proved successful. The spread of this disease may be prevented by not using infested hens for hatching eggs.

INTESTINAL WORMS

The most common intestinal worms are the round worms (*bulati*, Tag.), long, white, cylindrical worms, varying from a centimeter or less to more than ten centimeters in length, and the tape worms (*apad*, Tag.) which are long, flat, white, segmented worms. Intestinal worm infestations do not seem to cause mature fowls to suffer very much, but young chickens so affected become very thin, dull, and sleepy. Round worms if present in large numbers sometimes form into rather large balls and obstruct the passage of food materials through the intestines. Green tobacco leaves or tobacco dust are good expellers of round worms. The tobacco leaves are chopped fine and soaked in water, and the liquid used in wetting mash feed. For tape worms, rotation of the grounds at least once every two or three years is one of the best preventive measures known.

ANIMAL ENEMIES

Losses due to animal enemies as the *bayawak*, snakes, hawks, crows, *alimos*, dogs, and rats, are some of the main causes of failure in poultry raising. The flock should be well protected and guarded against these. The use of traps with dead chickens as bait is very effective against *bayawak* and rats. Scare-crows and a shot gun will help drive hawks and crows away. No dogs which have

the habit of chasing and killing chickens should be turned loose in the poultry yards. Finally, places where wild animals can hide themselves during the day should be cleared off.

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THE ANTHRACNOSE OF ABACA, OR MANILA HEMP¹

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The occurrence of the anthracnose of abaca, or Manila hemp (*Musa textilis* Neé) in the Philippines was recently reported by Ocfemia (1). Leaves of abaca seedlings varying from 5 to 10 centimeters in length and 2 to 4 centimeters in width are covered with dark brown or purplish circular or oval spots. In April and May, 1924, abaca fruit bunches severely attacked by anthracnose were collected from the abaca plantation of the Department of Agronomy on Mount Maquiling. An anthracnose of banana (*Musa sapientum* L.) was reported in 1922 (2). The writer has observed that although banana and abaca are two distinct species, they seem so closely related, that, so far as known, parasitic fungi on banana may be found on abaca also.

The object of this paper is to present the results obtained in work started in November, 1923, to determine the relationship between the *Gloeosporium* on abaca and *G. musarum* Cooke and Massee on banana; also to give observations which seem valuable in the control of the disease.

THE DISEASE

GEOGRAPHICAL DISTRIBUTION AND ECONOMIC IMPORTANCE

As far as the writer is aware the anthracnose of abaca has been reported from no abaca-growing districts in the Philippines, except Los Baños. Usually infection is general during the wet season on seedlings varying from 5 to 20 centimeters in height. The seedlings are not often killed by the infection and the disease is generally outgrown by the fast growing seedlings. The disease is only of minor economic importance as it produces only slight damage to abaca.

SYMPTOMS

On leaves.—Infections on leaves of seedlings appear as numerous purple or brown, circular or oval spots varying from 0.5 to 2.0 millimeters in width. In serious cases two or more of these minute spots may coalesce, forming larger irregular brown or purple lesions. On leaves of older plants, the patches are fewer in number but much larger. Sometimes oval or oblong lesions may be 10 to 15 centimeters in length by 5 to 10 centimeters in width, or even larger. Occasionally, under favorable conditions, a few of these oblong dead areas on the leaf blades may extend from the margin to the midrib.

On fruits.—In the early stages of the lesions on fruits the spots are circular, brown, and more or less sunken. It has been noted that lesions start commonly from slightly sun-scalded portions of the fruit bunch. The lesions increase in size and often merge with neighboring patches, forming larger irregular dark brown areas. It is not rare to find a bunch of fruit the entire half of which is brown and dead. From the center of the lesions and spreading all over the

¹ Experiment Station contribution No. 262. The writer is indebted to Dr. G. O. Ocfemia, Acting Head, Department of Plant Pathology, for helpful suggestions and advice during the progress of this work and preparation of the manuscript.

dead patches is formed a mat of moist pinkish masses of spores of *Gloeosporium*. In this type of infection the fruit bunch may be distorted. In rare cases, entire bunches of fruit may turn brown and rot.

CAUSAL ORGANISM

The organism was isolated by placing abundant conidia in melted corn meal agar which had been cooled to about 40° C. The tube containing the agar with the conidia suspended in it was rolled between the hands to distribute the spores more or less uniformly. Before the agar congealed it was poured in petri dishes and the spores were allowed to germinate. At germination, a sufficient number of isolated spores were picked up with a flattened platinum needle and transferred on corn meal agar slants or other suitable media.

The causal fungus was isolated by touching a fresh, moist, pinkish tuft of fruiting bodies with the tip of a sterile platinum needle and introducing the spores on the surface of potato-dextrose agar in petri dishes. In five to six hours the conidia germinated and isolated spores were readily cut with the flattened end of the platinum needle and introduced on potato-dextrose agar slants.

Isolation of the fungus was also made from incipient lesions on the leaves of the abaca seedlings. In this method, small sections were cut from the lesions, sterilized with 1:1000 mercuric chloride solution for forty to sixty seconds, and washed in three changes of sterile water. The sections were plated out in petri dishes containing potato-dextrose agar. From the growth on the tissues, transfers were made on slants of various agars.

MORPHOLOGY

Mycelium.—The mycelium produced in pure culture on corn meal agar was studied. The hyphae are septate and hyaline when young. As they grow old, they become compact and dark brown. In culture, hyphae gather together forming a net-work of stroma-like masses. The cells of the hyphae of the abaca strain vary from $4.5-30.5 \times 1.5-10.5 \mu$. The cells of the hyphae of the strain on banana vary from $2.5-32.5 \times 1.5-10.5 \mu$.

Conidiophores.—The conidiophores are erect and filiform, bearing a conidium at each apex. The conidiophores are arranged in a palisade-like mass. On account of the growth of these palisade-like conidiophores the epidermis of the host is pushed upwards and finally ruptured. The conidiophores of the abaca strain vary from 12.5 to 20.5 μ long. The strain on the banana produces conidiophores 11.5–18.5 μ long.

Conidia.—The conidia are thin-walled, hyaline, ellipsoid to elongate, continuous, and rounded at both ends. At germination a conidium may put up a septum in the middle. This septum is usually perpendicular to the long axis of the conidium. The conidia from pure cultures are larger than those from field materials. From field materials the conidia of the abaca strain are from $11.5-17.5 \times 3.5-5.5 \mu$, while in pure culture they are from $12.5-21.5 \times 3.5-6.5 \mu$. The conidia from field materials of the banana fungus vary from $10.5-19.5 \times 3.5-5.5 \mu$, and in pure culture they vary from $12.5-22.5 \times 3.5-5.55 \mu$.

When a conidium germinates it may produce a short germ tube bearing a conidium-like hyaline body. Each conidium may send out either one or two germ tubes. The greater number of these germ tubes are produced near the

poles; some few are at the poles. When a conidium germinates it may produce a dark chlamydospore-like structure at the distal end of the germ tube after 24 hours.

Acervuli.—Pinkish masses of fungus materials arranged in concentric rings are formed by the aggregation of hyphae into acervuli. The acervuli are moist and bright pink when young and may be covered with a delicate crust of hyphae which seems to hold the spores before they are ready for dissemination. In pure culture, black and rough stroma-like bodies are formed and these contain acervuli. The acervuli of the abaca strain of *Gloeosporium* in pure culture may vary from 94–304 μ in diameter. The acervuli of the *Gloeosporium* on the banana vary from 94–294 μ in diameter. No setae were found in the acervuli of the abaca and banana strains of the fungus, either from field materials or in pure culture. Perithecia-like bodies were observed in pure cultures of the abaca and banana *Gloeosporium*. No asci, however, were found in any of the perithecia-like structures.

COMPARATIVE CULTURAL STUDIES OF THE ABACA AND BANANA STRAINS

The growth of the fungus isolated from abaca and banana on various media and sterilized plant tissues was studied. Steamed unpolished rice was prepared by putting approximately the same number of rice grains in test tubes and covering them with tap water to three centimeters above the level of the grains. The tubes were plugged and autoclaved for 20 minutes at 15 pounds' pressure. The steamed plant tissues were prepared by cutting tissues into sizes which could be easily slipped into test tubes and approximately five centimeters long. Each cutting was then placed in a test tube at the bottom of which a piece of wet absorbent cotton had been inserted. The test tubes were plugged and sterilized in the autoclave for 20 minutes at 15 pounds' pressure. The agars were prepared in the manner recommended by various authors.

Water agar.—The abaca and banana strains produced poor growth but abundant acervuli began to form 12 days after the transfers were made.

Corn meal agar.—The growth of the abaca and banana strains was slow. Both produced little mycelial growth, but abundant acervuli developed.

Potato-dextrose agar.—Both strains produced luxuriant growth of mycelium, covering the entire surface of the slants in six days. Abundant acervuli were produced. The surface of the slants became rough on account of the presence of fruiting structures.

Potato cylinders.—On this substratum a good growth was produced by both strains. Sporulation started after five days and abundant acervuli developed.

Steamed unpolished rice.—A good growth was produced by both strains, developing abundant acervuli after five days.

Banana fruit cylinders.—There was a luxuriant mycelial growth by both strains, forming abundant acervuli after four days. A large number of black stroma-like growths containing acervuli was produced.

Corn meal.—Abundant mycelial growth covered the substratum in a few days and numerous stroma-like bodies containing acervuli were produced.

Oatmeal agar.—A good growth was produced by both strains and numerous acervuli formed in five days.

Steamed stems of avocado (Persea americana Mill.).—The abaca strain did not produce as good a growth as did the banana strain. In all cases, however, abundant conidia were produced in acervuli.

Steamed stems of mango (Mangifera indica L.).—Neither strain produced a good growth of hyphae, although abundant spores finally developed.

Steamed tomato stems and fruits.—Only a little growth was produced by each strain and sporulation was comparatively late. Acervuli were produced also.

Steamed eggplant stems and fruits.—Only a little mycelium was produced by both strains, but acervuli were copiously produced.

Steamed cowpea, pods, and stems.—A luxuriant growth of mycelium finally producing large quantities of conidia in acervuli developed.

Steamed pods and stems of (Canavalia gladiata L.).—Both strains grew vigorously and produced abundant acervuli.

Steamed pepper.—Neither strain grew vigorously on this substratum. A fair amount of spores and acervuli, however, was produced.

Steamed banana and abaca petioles.—Neither strain produced abundant mycelium. Numerous acervuli, however, developed.

Steamed stems of citrus.—Abundant mycelium and acervuli were produced by both strains.

Steamed petioles of papaya (Carica papaya L.).—A thick mycelial growth with numerous acervuli was produced.

From the results in cultural work with the fungus from banana and abaca, the writer found that the common media and steamed plant tissues are suitable for the spore production. Although in some cases very little mycelial growth was produced on the substratum, the spores produced in the acervuli were invariably sufficiently abundant. It was also noted that both strains behaved in the same manner on all media and substrata, except on avocado stems.

TAXONOMY

In 1922 the author concluded that the *Gloeosporium* on banana in the Philippines is *G. musarum* Cooke and Massee. This species of fungus is widely distributed in the banana-growing countries of the world. In comparative morphological, cultural, and inoculation studies using the *Gloeosporium* on abaca and *G. musarum* on banana, the author found that there are but minor differences in the two strains. These differences were insufficient to call the one a different species from the other. It was therefore concluded that the species attacking the abaca is the same as that causing disease on the banana. As stated in the first part of this paper, it seems as though the two species of *Musa* are so closely related, that so far as known, parasitic fungi on the one may also be found on the other.

PATHOGENICITY

Inoculation experiments to determine the relation of the *Gloeosporium musarum* to abaca, banana, and two other host plants attacked by anthracnose diseases in the Philippines were started in November, 1923, and continued until April, 1924. Inoculation was made by applying a thick spore suspension all over the nether surface of the leaves of plants out of doors. Inoculations were made on seedlings of abaca, banana, mango (*Mangifera indica* L.) and avocado (*Persea americana* Mill.). After the leaves were inoculated they were covered with gla-

cine bags with a little moist absorbent cotton inside to supply moisture to the surrounding air. Checks were run alongside the inoculated leaves, applying sterile water on the leaves before they were bagged. Besides leaves of plants in the field, fruits of abaca, banana, mango, avocado, *Citrus limonia* Osbeck, *Carica papaya* L., *Psidium guajava* L., *Anona muricata* L., *A. squamosa* L., *Solanum melongena* L. and *Lycopersicum esculentum* Mill. were inoculated. The fruits were washed with 1:1000 mercuric chloride solution. The disinfectant was removed with three to five changes of sterile distilled water. The fruits were inoculated through pricks made with the point of a sterile platinum needle applying the moist spore-masses on the pricked portions. The inoculated fruits, as well as the checks, were placed in damp chambers. On the control plants, only sterile water was applied on the surface of the leaves and fruits. It was found that in 24 to 72 hours, symptoms of the disease appeared in inoculated leaves and fruits of banana, abaca, mango, and avocado under field conditions, while the controls in each case were uninfected. The results of the experiments show that *Gloeosporium musarum* is capable of infecting abaca, banana, avocado, and mango. The cross inoculation work was done to find out if *G. musarum* is capable of producing anthracnose symptoms on plants attacked by fungi of the same general group.

In the inoculation of fruits in the laboratory it was found that infection took place in five to seven days on various fruits and vegetables. The results show, however, that *G. musarum* is not a dangerous storage rot fungus except with banana fruit. It was found that under favorable conditions the fungus can behave as a storage rot organism capable of attacking various common Philippine fruits and vegetables.

LIFE HISTORY OF GLOEOSPORIUM MUSARUM IN RELATION TO THE PRODUCTION OF ANTHRACNOSE ON ABACA

SOURCES OF INOCULUM AND SPORE DISSEMINATION

The sources of inoculum for field infection are the infected fruits and leaves which become covered with the pinkish masses of conidia borne in acervuli. These masses are at first moist, but later they become dry and almost white or gray. While the spores are fresh and moist they may be easily carried by insects or in drops of water when it rains. Fruits of bananas and abaca give off a mild smell of alcoholic fermentation when they begin to rot as a result of the attack of *G. musarum*. This odor attracts insects. Visiting insects may carry the moist masses of spores on their bodies. In this manner they cause the transfer of the organism from diseased to healthy fruits. As soon as the conidia are dry they are easily blown by the wind to neighboring plants, thus causing infection. Seedlings in the field and young plants are infected by conidia which are blown to them by the wind or carried by drops of water during a rain. The fruits of abaca are full of seeds. Seeds, obtained from overripe fruits which are infected, produce infected seedlings if planted without sterilization. No work, however, was done to determine if the fungus is also carried within the seeds.

Spore catching experiments exposing sterile potato-dextrose agar in petri dishes at different points in the field showed that the conidia of *G. musarum* on abaca may be blown by the wind easily from plant to plant. Under laboratory conditions, experiments using insects showed that dissemination of spores may be made by fruit flies which visit infected and rotting abaca fruits.

INFECTION OF ABACA IN THE FIELD

At the beginning of the rainy season the abaca plants are still rather weak from the effect of the dry weather. Infection of leaves of seedlings and of mature plants and fruits takes place on slightly sun-scalded or weakened portions. These infections progress very rapidly during the wet season and abundant conidia are produced throughout the rainy months, causing secondary infections.

METHOD OF PASSING OVER THE DRY SEASON

Infected bunches of abaca fruit become wrinkled, dark brown, and dry. The masses of fruiting structures become dirty white or gray. Dastur (3) states that the spores of the *Gloeosporium* on banana remain alive in the acervuli for nine months. Although no experimental work has been done to find out how the fungus on the abaca passes through the dry season, and how long the spores can remain viable, observations seem to show that the conidia are capable of withstanding the dessicated condition during the dry season in the Philippines. Infected fruits and leaves lying on the ground in the field are well protected from intense heat and sunlight by the shade of the leaves of living abaca plants and by weeds.

CONTROL MEASURES

Two things of fundamental importance in the control of the anthracnose of abaca have been observed. During the course of the work the author noted that abaca seedlings are very badly infected when they are from 10 to 20 centimeters tall. He observed, however, that the fast growing seedlings soon produce leaves which are free from lesions, showing that seedlings finally outgrow infection. From this observation it seems that by selecting vigorous seedlings from seed beds and forcing them to grow in rich soil, seedling infection may be reduced to the minimum, if not totally controlled.

Another observation of interest in the reduction of damage caused by the disease is that the points of infection on abaca fruit and leaves of grown plants are on portions exposed to direct sunlight. During the dry season these points become somewhat sun-scalded and weakened. As a consequence of this weakened condition leaves and fruits are easily attacked by the disease. The disease has been observed thus far on fruit bunches of plants more or less weakened owing to lack of shade during the dry season. No infection has been observed so far on bunches from vigorous plants and from hills well located with regard to shade. From these observations it seems that the prevalence of the disease may be reduced by promoting good growth of abaca plants, and by planting shade trees where they are needed in the field.

In addition to these precautions it is, of course, necessary to protect plants from infection by reducing sources of inoculum under field conditions.

DISCUSSION OF RESULTS

In the present study it has been found that *Gloeosporium musarum* on the banana also attacks leaves and petioles of abaca seedlings, leaves of grown plants, and fruits. The disease has been found, however, only on leaves and petioles of very young seedlings and on weakened leaves and fruits of abaca. It was found also that the infection on leaves and petioles of seedlings is finally outgrown by the plants, especially by the fast growing individuals.

Although some phases of the life history of *Gloeosporium musarum* on the abaca need to be worked out before definite statements can be made, no further attention was given to the fungus, inasmuch as it is only of minor economic importance. The writer is of the opinion that improvement of cultural methods and protection of the leaves and fruits of abaca from intense heat of the sun during the dry season by planting shade trees in the field will reduce field infection a great deal, and may totally eradicate it. The production of fast growing seedlings that will outgrow the disease in seed beds by "forcing" will reduce infection. Whether plants grown in ideal abaca localities are as subject to the disease as those grown in places visited by drought and typhoons yearly remains to be determined. Observations made in the field where the present study was conducted, however, showed that the disease infects only weakened abaca plants. Infection on very young seedlings seems to indicate that the disease attacks the young plants during a critical stage, or that period when the seedlings, having exhausted the reserve food in the seed, are just beginning to absorb their own food materials from the soil and to manufacture their own organic foods. This observation is supported by the fact that as seedlings grow larger the subsequent leaves that develop are little infected or are entirely free from the disease.

Avocado and the mango are two important hosts of anthracnose diseases in the Philippines. These plants have been included in the cross inoculation work with the abaca fungus. The relations of the various species, or forms of *Gloeosporium* on various economic hosts, to one another have not been studied. In this work it was found that the abaca strain is capable of causing infection on banana, avocado, and mango. The results from cross inoculation studies are of value because anthracnose diseases of mango and avocado occur in the Philippines and in other tropical and sub-tropical countries.

Under favorable conditions *Gloeosporium musarum* is capable of producing storage rots on fruits and vegetables.

SUMMARY

1. The anthracnose disease of banana, caused by *Gloeosporium musarum* occurring in the Philippines also attacks abaca. The disease, however, is only of minor economic importance.

2. The disease attacks leaves of young seedlings grown from abaca seeds, leaves of mature plants, and fruits. On leaves, the spots may be very numerous and small, or they may be few but large lesions. On fruits the lesions may also be small spots confined to individual fruits or under favorable conditions the infection may involve the entire half of a bunch.

3. The strain of *Gloeosporium musarum* on the abaca varies in certain minor respects from the banana strain but the difference is not sufficient to warrant a separation of the two strains into two distinct species.

4. The fungus produces spores throughout the rainy season. The spores may be carried either by wind, by rain, or by insects from the source to points of infection.

5. The fungus attacks leaves and petioles of very young seedlings. The disease, however, is outgrown by the fast growing seedlings. Infection on leaves of mature plants and on fruits takes place on parts weakened by exposure to intense heat of the sun during the dry season.

6. Infection of seedlings may be controlled by producing fast growing seedlings which outgrow the disease. By providing proper shade plants for abaca during the dry season, infection of leaves of mature plants and of abaca fruits may be controlled.

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²It is a matter of regret that the article "Studies on banana anthracnose" by RAFAEL A. TORO, *The Journal of the Department Agriculture of Porto Rico* **6**: 1-23. Pl. 1-4, fig. 1-24. 1922, was received after this paper was in press, too late for reference. J. A. A.

CORRELATION BETWEEN NUMBER OF LEAVES AND HEIGHT OF *NICOTIANA TABACUM*¹

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INTRODUCTION

The correlation between the number of leaves and the height of *Nicotiana tabacum* L. is of sufficient importance to be given a comprehensive study by plant breeders. In the Philippines as tobacco is one of the country's principal agricultural crops it is especially important that facts regarding correlation between parts of the tobacco plant should be known. Where correlations between economic characters of tobacco exist, they enable the farmer to judge one character by the appearance of another. Frequently, correlation is of such a nature that the farmer may judge the relation between two characters, even when one is easily seen and readily measured and the other is not. For example, it has been found that broad leaf base is correlated with early flowering. A selection of a broad leaf base, then, means a selection for early flowering plants. It is obvious that such conditions have an important bearing upon plant improvement, as selection with reference to a single character would have a definite effect upon certain other characters.

REVIEW OF PAST WORK ON CORRELATION BETWEEN TOBACCO CHARACTERS

There is little available literature on correlation of tobacco characters.

Hayes (1912) (1) studied correlation of tobacco characters and used two types of tobacco and the first and second generations of crosses between them. He found that there was a positive correlation between the number of leaves and height of tobacco plant. The coefficient of correlation, with one exception, was in all cases less than 0.5. The correlation between number of leaves and average leaf area was in all cases negative and very slight. This means that a large number of leaves was associated slightly with a smaller average leaf area. The correlation between length and width of leaf was also studied by Hayes. He found a distinct positive correlation between these two characters.

Ridgway (1916) (2) in the tobacco he studied, found a correlation between the grain and burning properties. He believed that the substances contained in the grain bodies are injurious to the burn of tobacco. He stated that the quality of the burn is dependent upon the degree to which the grain bodies are aggregated into definite bodies; these are sufficiently separated one from the other to permit a considerable fire-carrying zone of cells, emptied of grain material, around each. The investigation reported by Ridgway was made by means of a microscopical examination. The coefficient of correlation was not determined by the mathematical method.

Honing (1920) (3) found positive correlation between: (a) broad leaf base and early flowering, (b) constricted leaf base and late maturity, and (c) abundant foliage and constricted leaf base and late flowering.

¹ Experiment Station contribution No. 263. The writer is indebted to Dean C. F. Baker and Dr. Nemesio B. Mendiola for helpful suggestions and criticisms in the preparation of this paper.

OBJECTS OF THE PRESENT WORK

The objects of this paper are: (a) To express in a single number the relation which exists between two groups of data on several hundred individuals and (b) To place on record the observations on correlation which have been made in this study, and to discuss the bearing of the facts observed on the methods of improvement of the tobacco crop in the Philippines.

TIME AND PLACE OF THE WORK

The work here reported was begun in March and closed in August, 1924. The cultures were conducted in the field near the Agronomy Tobacco House of the College of Agriculture, Los Baños. The weather was favorable for the growth of the tobacco plant. The soil is not as uniform in fertility as might be desired for the experiment, but care was taken to discard all plants which appeared to have been favored by manure or other factors.

MATERIALS AND METHODS

The materials used for the study are given in Table I. The varieties had been inbred for a number of years and found to be uniform as to type.

TABLE I.—*Hybrids and parents used in the experiment.*
Hybrids.

Name.	Male parent.	Female parent.
Hybrid No. 1 F ₃	Improved Gold Leaf F ₄	Repollo F ₃
Hybrid No. 2 F ₃	Improved Gold Leaf F ₄	San Antonio F ₂
Hybrid No. 3 F ₃	Connecticut Havana F ₄	San Juan Batec F ₂
Hybrid No. 4 F ₃	Connecticut Havana F ₄	Romero F ₂
Hybrid No. 5 F ₃	Improved Gold Leaf F ₄	Romero F ₂
Hybrid No. 6 F ₃	Connecticut Havana F ₄	Repollo F ₃
Hybrid No. 7 F ₃	Connecticut Havana F ₄	Dammao Broad Leaf F ₃

Parents.

Improved Gold Leaf, College Number 7808 F₄,
Connecticut Havana, College Number 4828 F₄,
Repollo, College Number 9976 F₃,
San Antonio, College Number 17099 F₂,
San Juan Batec, College Number 17227 F₂,
Romero, College Number 7891 F₂,
Dammao Broad Leaf, College Number 9975 F₃.

The 2,513 plants used in this study were examined after all the sand leaves, standard leaves, and top leaves had been gathered. The total number of leaves and height of each plant were determined at the same time. All the plants in each variety were uprooted and the height and number of leaves per plant determined. By means of a rod graduated to centimeters, height was measured from the point where the roots begin to the apex of the stem. The measurement was expressed to the nearest centimeter. After the height was measured, the uprooted plant was washed clean and all the leaf scars and the remaining leaves counted. At the base of the plant where the leaf scars were close together the counting was done by marking with a slight cut made with a knife the point of commencement, and then counting the subsequent scars and cutting them off with a knife at the same time. After all the scars were removed they were com-

pared as to number with the cut parts on the stem. All the leaves borne on the main stem were counted; the leaves on the secondary branches at the top of the main stem were not included.

In determining the coefficient of correlation the usual correlation table was employed. Barlow's Tables of Squares, Cubes, Square Roots, Cube Roots, etc., was used freely (4).

DISCUSSION OF RESULTS

For convenience in discussing the results, the coefficient of correlation between the total number of leaves and height found in each variety is given in the following table:

TABLE II.—Coefficient of correlation between total number of leaves and height per plant and standard deviations for height and number of leaves of the varieties used.

Name.	Standard deviation.		Coefficient of correlation.	Probable error.
	Height.	Number of leaves.		
Hybrid No. 1 F ₃	31.96 ± 1.53	6.04 ± 0.29	+0.336	± .0426
Hybrid No. 2 F ₃	39.46 ± 1.77	7.25 ± 0.32	+0.236	± .0424
Hybrid No. 3 F ₃	41.20 ± 1.38	7.44 ± 0.25	+0.465	± .0264
Hybrid No. 4 F ₃	38.64 ± 1.73	6.84 ± 0.30	+0.164	± .0436
Hybrid No. 5 F ₃	38.44 ± 2.16	4.77 ± 0.26	+0.420	± .0460
Hybrid No. 6 F ₃	31.75 ± 1.25	10.14 ± 0.40	+0.220	± .0377
Hybrid No. 7 F ₃	38.50 ± 1.85	6.13 ± 0.29	+0.253	± .0452
San Juan Batec, College Number 17227 F ₂	37.54 ± 2.53	7.55 ± 0.50	+0.391	± .0571
Repollo, College Number 9976 F ₃	24.39 ± 1.64	5.80 ± 0.39	+0.433	± .0546
San Antonio, College Number 17099 F ₃ ..	25.84 ± 1.74	5.20 ± 0.35	+0.514	± .0496
Connecticut Havana, College Num. 4828 F ₄	27.92 ± 1.71	7.57 ± 0.46	+0.221	± .0583
Improved Gold Leaf, College Num. 7808 F ₄	27.44 ± 1.68	5.15 ± 0.31	+0.588	± .0401
Romero, College Number 7891 F ₂	42.10 ± 2.02	7.54 ± 0.36	+0.236	± .0454
Dammao Broad Leaf, College Num. 9975 F ₃	31.43 ± 2.11	6.41 ± 0.43	+0.472	± .0524

The degree of association between the characters in question is shown by the coefficient of correlation.

King in his "Elements of Statistical Method" (5) gives the following statements regarding coefficient of correlation according to its relation to the probable error:

- (1) If the coefficient of correlation is less than the probable error there is no evidence whatsoever of correlation.
- (2) If the coefficient of correlation is more than six times the size of probable error, the existence of correlation is a practical certainty.
- (3) If the coefficient of correlation is less than 0.3, the correlation cannot be considered at all marked.
- (4) If the coefficient of correlation is above 0.50 there is a decided correlation.

East says that the coefficient of correlation should be over 0.50 to be of value to the plant breeders.

Applying these rules to the results in Table II, it may be seen that the existence of correlation in Hybrid No. 1 F₃, Hybrid No. 3 F₃, Hybrid No. 5 F₃, San Juan Batec, Repollo, San Antonio, Improved Golf Leaf, and Dammao Broad Leaf, is a practical certainty, because the coefficient of correlation is more than six times the size of probable error.

In Hybrid No. 2 F_3 , Hybrid No. 4 F_3 , Hybrid No. 6 F_3 , Hybrid No. 7 F_3 , Connecticut Havana and Romero, the coefficient of correlation is less than 0.3 and therefore the correlation cannot be considered at all marked. From the viewpoint of the plant breeder, this is probably of no great significance.

There is a decided correlation between the total number of leaves and height of the plants in San Antonio and Improved Gold Leaf. The coefficients of correlation in these two varieties are $+0.514 \pm 0.0496$ and $+0.588 \pm 0.0401$, respectively.

There is a positive correlation between the total number of leaves and height of tobacco plant in all cases. The correlation in each variety reported in this paper is less than 0.50 except in San Antonio and Improved Gold Leaf.

CONCLUSIONS

From the results obtained in this study, the following conclusions are given:

1. There is a positive correlation between the total number of leaves and height of the varieties studied.
2. The coefficient of correlation is less than 0.50 in all the varieties reported, except in the cases of Improved Gold Leaf, College Number 7808 F_1 , and San Antonio, College Number 17099 F_2 .
3. The degree of mutual relation between the total number of leaves and height of tobacco plant as shown by the coefficient of correlations depends upon the variety. It is believed that if a population is homozygous, genetically, the coefficient of correlation will be very small. On the other hand, if the coefficient of correlation for a mixed population is determined, the value will be very high.
4. In the farmers' common practice of selecting seeds from the tall plants in the field, there is a tendency to unconsciously choose plants with the larger number of leaves, although there is no very great correlation between the total number of leaves and height of the tobacco plant.

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THE ODOR OF AMORPHOPHALLUS CAMPANULATUS¹

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Five species of tropical Asiatic genus *Amorphophallus* have been recorded from the Philippines, the commonest species being *A. campanulatus* (Roxb) Blume, the *puñgapung*. This plant has a wide geographical range, extending from India through Malaya to the Fiji Islands on the one hand, and to Madagascar on the other (1). In the Philippines it is a common *parang* plant, occurring along trails and in secondary forests. The large single leaves appear at the beginning of the rainy season, and often reach a height of about three meters under specially favorable conditions. The petiole is green, mottled with gray, and covered with its much-divided trisections spreads horizontally, giving the plant a very characteristic appearance shared only by some members of the same genus. The leaves die during the hot dry season and the inflorescence appears after the first rains of the wet season, about the end of May at Los Baños. This inflorescence or "flower" is of the usual aroid type, but the spathe is broadly campanulate. The spadix is stout, and a relatively short part of it is devoted to flower-bearing. The female flowers occupy the lower zone, the males occurring above them. The rest of the spadix is expanded into a large crumpled appendage of a purple color, fibrous and spongy within. The size of the inflorescence, 20-40 centimeters in diameter with a spadix 25-36 centimeters in height, is sufficient in itself to attract attention to the plant, but its chief characteristic is the strong carrion smell. This smell is one of the least pleasing features of the opening of the rainy season. The odor is a characteristic of *Amorphophallus* and Willis (2) remarks that carrion flies attracted by it sometimes lay their eggs in the spadix. The object of the observations presented in this paper was the determination of the origin and nature of the odor.

MATURATION OF THE INFLORESCENCE

The spadix in its earliest stages after appearance above the ground gradually opens out disclosing the velvety-surfaced appendage. Just before it has opened fully the odor becomes apparent; the velvety surface begins to delequesce. The female flowers are now mature and ready for fertilization. Very soon flies, attracted by the smell, are found crawling over the appendage and the male and female flowers. Many of them have pollen from other *Amorphophallus* flowers adhering to them. From twenty-four to forty-eight hours pass before the male flowers mature. Pollen then commences to exude from their anthers in long sticky strings, and, falling, comes into contact with the female flowers. Any unfertilized flowers may therefore be self-pollinated if insect pollination fails. The amount of pollen is very considerable and it collects in the base of campanulate spathe in a thick layer.

After the shedding of the pollen the odor of the appendage becomes weaker and the structure collapses. The smell finally resolves itself into that of ordinary

¹Experiment Station contribution No. 264.

decaying vegetable tissue. The inflorescence as a whole, however, continues to emit an effluvium, and this is due to the decaying mass of waste pollen at the base of the spathe. The flies turn their attention to this and lay their eggs in it.

A number of inflorescences in various stages were examined for the purpose of determining the nature of the odor. The purple appendage is the region from which this is produced, the flowers themselves being odorless. The coloration is due to the presence of anthocyanin in the surface cells, and is not correlated with the production of the smell, as it is also present in the spathe and other parts of the plant. The cells of the young appendage are packed with protein, and in the older specimens, where the foetid odor has commenced, the amount is considerably less; in very old wilted specimens very little protein is to be found. From the nature of the odor and the microscopic evidence it is concluded that the typical odor of *Amorphophallus campanulatus* is due to the decomposition of protein in the appendage. The putrefaction of the excess pollen results in an extension of the period of foetidity, but is of no biological importance to the inflorescence, the female flowers having already been fertilized. This decomposition is evidently a drawback to the plant as the tissue at the base of the spadix frequently becomes infected and rots before the seeds mature.

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ABSTRACT

The relation of soil temperature to germination of certain Philippine upland and lowland varieties of rice and infection by the *Helminthosporium* disease. GERARDO OFFIMARIA OCFEMIA. *The American Journal of Botany* 11: 437-640. Pl. 29-32. 1924. *Experiment Station contribution No. 265*. The author discusses the results of experiments on the relation of soil temperature to germination of certain Philippine upland and lowland varieties of rice and infection by the *Helminthosporium* disease conducted in the Department of Plant Pathology of the University of Wisconsin, Madison, Wisconsin from 1921 to 1923. The work was conducted to determine if there is a difference in temperature relations of the rice seedlings and of the seedling blight fungus *Helminthosporium oryzae* Breda de Haan which might be of some application in the control of the disease.

According to the author, experiments conducted to determine the effect of soil temperatures from 16° to 40° C. at 4° intervals, with soil moisture varying from 16 to 100 per cent of the water-holding capacity, upon the germination of rice showed that emergence occurred in from one to four days at 36° and 32° C., in from four to seven days at 28° C., in from five to nine days at 24° C., in from two to six days at 40° C., in from six to thirteen days at 20° C., and in from nine to sixteen days at 16° C. The best subsequent development of the seedlings was found to take place from 28° to 32° C. It is also reported that sterilizing the soil for a long time under high steam pressure did not produce much effect upon the rate of germination or the time of emergence of rice seedlings. The quality of the seed is reported to affect the percentage of germination at soil temperatures from 16° to 24° C. Above this soil temperature, however, the influence of seed borne parasites became less effective.

In artificial inoculation of rice with pure cultures of *Helminthosporium oryzae*, applying the fungus on the grains at the time of planting, it is reported that seedlings were infected at soil temperatures from 16° to 36° C. The development of the lesions on the aerial parts of rice was much faster from 28° to 32° C., because of the rapid growth of the fungus and of rice seedlings at these temperatures. According to the paper, severe blighting of seedlings before emergence occurred at 16° to 24° C. At 36° C. the percentage of infection was low and the growth of the lesions comparatively slow. Although rice seedlings emerged much faster through the soil at 36° C. the temperature is beyond the optimum for the subsequent development of the seedlings.

The temperatures favorable for the growth and sporulation of *H. oryzae* in pure culture on potato-dextrose agar and for the growth of Philippine upland and lowland varieties of rice were nearly the same. The development of the lesions was most rapid at temperatures at which the subsequent growth of rice was best. A more severe infection, resulting in blighting of seedlings before emergence, occurred at soil temperature from 16° to 24° C. At 36° C. only an occasional blighting of seedlings occurred. The results of experiments conducted by the author in constant temperature and moisture chambers show

that soil temperature rather than air temperature influences the infection by the *Helminthosporium* disease. From these results the author believes that planting rice in soil or in seed beds during the warmer part of the year, or starting seedlings in seed beds with temperatures from 32° to 36° C., and holding the temperature of the seedbeds at 32° C. until the seedlings are transplanted will materially reduce infection and blighting by *H. oryzae*.

According to the paper, although coleoptile, mesocotyl, and seedling-root infections are more abundant and the lesions on aerial and subterranean portions develop faster at higher soil temperatures, that is, from 28° to 32° C. they are less harmful and are finally outgrown by the rice seedlings. At lower temperatures on the other hand, even coleoptile, mesocotyl, and seedling-root infections are conducive to blighting after the seedlings have emerged through the soil on account of the fact that these tissues are crisp and tender at lower soil temperatures and consequently more readily penetrated by the fungus mycelium of *H. oryzae*.

—Abstract by G. O. Ocfemia.

EXCHANGE NOTES

The Japanese beetle is one of the most serious insect pests attacking plant life. Its range of host plants is great, over two hundred different plants having been found infested in New Jersey. It feeds on foliage and fruits as an adult and on the roots of grasses as a grub. Shade and ornamental trees are attacked, as well as fruit trees. * * *

For some years past the Plant Commissioner and his staff have from time to time called attention through talks and publications to the fact that the Japanese Beetle (*Popillia japonica* Newm.) constituted a serious menace to the horticultural interests of this country. This pest was introduced into the United States, it is believed, through the medium of a shipment of iris bulbs from Japan consigned to a large nursery concern operating at Riverton, New Jersey, but having offices in Philadelphia. In 1916 only about half a square mile of territory was infested. The spread has been progressive, notwithstanding the repressive measures made use of. In 1922 over seven hundred square miles were involved. * * * The writer has been informed that a live beetle was found on a passenger, arriving at Savannah by steamer from Philadelphia a few days since. * * *

—*Quarterly Bulletin* (State Plant Board of Florida).

Mosquitoes frequently attack birds, and may harm them considerably by sucking their blood and causing them restless nights. Although we have no evidence that they can transmit disease to poultry in this country, it may be of interest to recall that bird malaria, which occurs in wild birds in some countries, has been definitely proved to be transmitted by several different species of mosquitoes. No less than about 1,000 different species of mosquitoes are known to occur throughout the world, and of these about 60 have been found in South Africa. The females of the majority of known species are blood-suckers, feeding on man, animals, and birds. On the other hand, all the males and the females of a few species are incapable of piercing the skin, and derive their nourishment chiefly by sucking the nectar of flowers.

—*Journal of the Department of Agriculture* (Union of South Africa).

Not the least among the many romances of tropical plant industry has been the rise of pineapple production. A native of Central America, the pineapple has been widely distributed and is now found under cultivation on a large scale in Florida, Cuba, Porto Rico, Straits Settlement, Queensland, India, the Azores, South Africa and especially in the islands of Hawaii. It is the last-named territory which offers the most remarkable picture of the phenomenal development under highly organized conditions of a new industry. From a small beginning some twenty years ago the Hawaiian islands have now become the principal source of pineapples. In 1903 the output was only 1,893 cases, in 1912 it was 1,300,000 cases, in 1921 it was 6,000,000 cases, and it is predicted that in 1925

it will be 10,000,000 and that the world's demand will be from 15,000,000 to 20,000,000 cases. * * *

In general it can be truthfully laid down that the distributive end of pineapple production makes greater claims upon knowledge, organization and capital than the production of the fruit itself. * * *

It may safely be claimed that the success in Hawaii is due to mass production, intelligent propaganda and advertising and to the confidence of capitalists in the industry. It also has to be borne in mind that Hawaii has an enormous and safe market in the United States and has also established itself as the principal supplier for Europe.

—*Tropical Agriculture.*

The blue color of the atmosphere is caused by a stratum of frozen, crystalline nitrogen in extremely high altitudes, according to theories recently put forward by Dr. L. Vegard. * * *

—*Science.*

Modern tropical agriculture is entirely a response to the industrial stimulus of the nineteenth century, and the prosperity of tropical agriculture ebbs and flows according to the wants and requirements of northern countries and the competition of warmer countries producing similar tropical produce under different circumstances. Concerning cotton, an exceptionally arresting instance of industrial development and decline is to be seen in the West Indies as the result of the present absence of demand for Sea Island Cotton. The development of that little industry was brought about by enterprise, science, organization; its troubles were investigated and largely remedied, and a bio-economic machinery evolved which in respect of a tropical industry has not been equalled in any other part of the world. Now after all the pains expended there is a possibility that it will be necessary to substitute something in its place after it has actually functioned as the economic salvation of at least four islands. It would seem to be evident that something more than the old type of farmer's outlook is needed in agriculture today, something more than a knowledge of technique and so-called practical work or even ordinary science. In tropical agriculture we are at work with vast forces of growth, competition and changes, and the present showing seems to be that the only way to meet them is by means of mass production; namely, the growth of produce on the largest scale and on the most industrialized and scientific basis—until circumstances alter to change our point of view and show the necessity for adopting some other and equally radical policy of procedure. * * *

—*Tropical Agriculture.*

The higher up in life a man goes, the more necessary it becomes that he shall coöperate with other men. Any man's success depends largely upon the effort of others, and any one who is not willing to share his success with these others very seldom has much success to share.

—*Edison Round Table.*

COLLEGE AND ALUMNI NOTES

Mr. W. C. Hall and Mr. A. M. Simpson of the Honolulu Iron Works and Mr. Herbert Walker of the Philippine Sugar Centrals Agency visited the U. P. Sugar Mill recently.

Assistant Professor Thomas F. O'Leary, appointed to the staff of the Department of English, arrived at the College the latter part of October. Professor O'Leary was graduated with degree of A. B. from the University of Michigan.

Dr. Manuel L. Roxas, Head of the Department of Chemistry, has been granted one year's leave of absence by the Board of Regents with permission to work in a sugar central. Doctor Roxas is working in the Pampanga Sugar Mills at Del Carmen, Pampanga.

Prof. Emma S. Yule of the English Department has completed arrangements with Rand McNally and Company for publication of "In Kimono Land," a geography reader for children. The book, through stories and illustrations from photographs, many taken under direct supervision of author, will tell of the life of Japanese children.

Dr. Francisco O. Santos of the Department of Chemistry has been appointed by the Secretary of Public Instruction as a member of the Committee on Beri-beri control. A pamphlet on the "A, B, C of Filipino Nutrition" prepared by Doctor Santos has been recommended by the Committee for publication and distribution in the public schools.

Mr. Josefino de la Peña, a farmer in Negros Occidental, donated two three-roll mills to the College of Agriculture. The Sugar students are especially grateful for the generous gift.

Mr. Cecilio Alincaestre, instructor in chemistry, has returned from the United States. Mr. Alincaestre, as a U. P. Fellow, studied first in Massachusetts Institute of Technology where he obtained the degree of B.S.M.E. He then went to Louisiana State University where he received M.S. in Sugar Engineering. He was elected to membership in the American Society of Mechanical Engineers.

At the last meeting of the Los Baños Biological Club, Professor Higgins spoke upon "Refrigeration of Mangoes"; Doctor Uichanco upon "Notes on the Embryonic Development of the Sugar Cane Bud Moth"; Doctor Quisumbing upon "The Continuity of Protoplasm in the Endosperm Cells of Diospyros".

The *Makiling Echo*, Forest School quarterly journal (mimeographed) under date of October contains many articles of interest, among which are: "Rubber Plantations as a Forest Industry" by A. M. Muzzal; "Fish and Game of Rizal and Cavite" by Vicente J. Defensor; "Geology and Soils" by R. F. Wendover; "Bukidnon Land Classifications" by Agapito Cenabre.

The Chemistry Department has organized a club named "Andelros" in honor of Anacleto del Rosario, the foremost Filipino chemist. This club has been admitted to corporation membership in the American Chemical Society and is a subscriber to: *Journal of the American Chemical Society*, *Journal of Industrial and Engineering Chemistry*, *Chemical Abstracts*, and *Physiological Reviews*. The officers are: Chairman, Francisco O. Santos; Vice-Chairman, Cecilio Alincaestre; Secretary-Treasurer, Felipe T. Adriano.

Construction work on permanent cattle barns for the Department of Animal Husbandry is in progress. These barns with the main building of the department will form a quadrangle. This plan is novel in that it places the herds close to the classrooms, making the animals readily accessible for class demonstration and practice. The expense of construction is being paid from the department's newly created revolving fund.

The Makiling School, a private school conducted for the benefit of the children of the faculties of the College of Agriculture, College of Veterinary Science, and Forest School, has moved into its spacious new quarters on the first floor of the residence of Doctor Gonzalez on Faculty Hill. Mrs. A. W. Adolfo, a graduate of the Philippine Normal School, is the teacher in charge.

The U. P. Sugar Mill has been greatly improved by the addition of a Buffalo scale, a framed standard filter press 24" X 24", bagasse carrier, and a repair shop.

The limeter invented by Dr. Manuel L. Roxas is to be tried by the Mabalacat Sugar Company.

Mr. Leon Gonzalez, M. S. '23, who left for the United States in July to pursue graduate studies, is now located at Cornell University where he has been able to make favorable arrangements for work in pomology and related subjects.

Mr. Alex Gordon, B. Agr. '23, on the advice of the Educational Agent for Filipino students in United States, changed his plans and is now in Cornell University. He writes from the address: 125 College Ave., Ithaca, N. Y.

Getulio Guanzon, Gonzalo Salazar, Irineo Sevilla, seniors in Sugar Technology, have finished the academic requirements in the course and have gone for practice work in centrals. Messrs. Guanzon and Salazar are with the Bacolod-Murcia Milling Company and Mr. Sevilla is at the Ma-ao Sugar Central.

Nicolas Grecia and Mauricio Jaramilla, both juniors in Sugar Technology have gone with Doctor Roxas to the Pampanga Sugar Mills for the practice mill work required in the course and to carry out the investigation necessary for their graduation theses.